UDC 666.3-431:666.951

NEW COMPOSITION FOR FABRICATING DIATOMACEOUS HEAT-INSULATING BRICK

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Translated from *Steklo i Keramika*, No. 3, pp. 33 – 34, March, 2010.

A mix composition has been developed making it possible to obtain on the basis of diatomite from the Inzenskoe deposit (Ul'yanovsk Oblast') a heat-insulating brick with good strength characteristics exceeding previous values by a factor of 4 – 5: compression strength 5.5 – 6.5 MPa, density 0.5 – 0.6 kg/cm^3, thermal conductivity at 25°C 0.09 W/(m · K), and structure factor 0.95.

Key words: ceramic, mix, diatomite, heat-insulation.

The abundance of amorphous silica rocks on Russian territory makes all work on obtaining from them building and finishing materials, heat-insulating brick, and artificial porous fillers for concrete very promising.

There are many deposits of diatomite and opoka on Russian territory within Middle and Lower Povolozh'e. In Ul'yanovsk Oblast', deposits of diatomite have been explored at the Zinov'evka station (town of Inza) and other locations. According to the data of [1], the thickness of the Inza formation of diatomite reaches 55 m, and the opoka formation reaches 30 m. Heat-insulating firing articles in the form of brick, shells and segments, as well as open filler for concrete are produced by "Diatomit-Invest" JSC (Ul'yanovsk Oblast') on the basis of diatomite. Two types of heat-insulating brick are produced: foam-diatomaceous articles by means of the slip technology and diatomaceous articles obtained by introducing burn-out additives by plastic molding technology. The drawback of these articles is low strength.

A mix composition making it possible to obtain on the basis of diatomite a strong heat-insulating brick whose strength characteristics are four to five times greater than previous such indicators (RF Patent No. 2909793) has been developed at the Kazan State Architectural-Building University.

The raw material was Inza diatomite, which is amorphous silica and light, porous, and loose and slightly clayey in places, with the following properties: molding moisture content of diatomite — 50 – 60%, refractoriness — 1450 – 1560°C, water absorption — 43.3 – 66.7%, true density — 2.15 – 2.2 g/cm^3, apparent density — 0.70 – 0.97 g/cm^3, and total porosity 54.9 – 67.5%.

According to the data obtained by All-Russia Scientific – Research Institute of Geology and Interior of the Earth (Republic of Tatarstan), Inza diatomite is an opaline-cristobalite rock with an admixture of feldspar, muscovite, and glauconite and containing 30 – 50%[3] active silica. The chemical composition of diatomite (according to the All-Russia Scientific – Research Institute of Geology and Interior of the Earth data) is as follows (%): 79.46 – 84.98 SiO_2, 4.43 – 8.37 Al_2O_3, 0.75 – 2.86 Fe_2O_3, 0.01 – 0.29 FeO, 0.19 – 0.41 TiO_2, 0.45 – 1.90 CaO, 0.47 – 0.97 MgO, traces — 0.02 SO_3, 0.96 – 1.25 K_2O, 0.18 – 0.98 Na_2O, and 5.44 – 6.59 other impurities.

According to [2], 1.1 – 1.5 m^3 sawdust and 550 – 600 kg diatomite, which amounts to 35 – 50% sawdust relative to the diatomite mass, is used per 1 m^3 of diatomaceous articles obtained by burning out additives. For this content of sawdust it is impossible to obtain brick with even edges, so that the finished bricks must be straightened out with a circular saw.

The objective of the present investigation is to obtain brick with an attractive facing and prescribed heat-insulating properties. For this, two types of additives were used: those that increase the strength of the ceramic and those that decrease the weight of the ceramic. Fluxes as well as limestone and sawdust served as complex additives. The burnable additives consisted of sawdust from cross-cutting. Diatomaceous dust — wastes from the production of diatomaceous brick — was also introduced. The ratio of the components was determined experimentally.

The weight contents of the components were in the following ranges (%): 61 – 55 diatomite, 2 – 5 diatomite dust, 8 – 13 liquid glass, 20 – 27 sawdust, and 50 – 60 water.

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[3] Here and below — content by weight.

TABLE 1.

Mix components	Content, wt.%, in the composition					
	1	2	3	4	5	6
Diatomite	62	65	65	61	68	55
Diatomaceous wastes (dust)	3	–	–	2	4	5
Liquid glass	10	10	10	15	8	13
Sawdust	25	25	25	22	20	27

TABLE 2.

Indicator	Composition					
	1	2	3	4	5	6
Compression strength, MPa	4.23	4.31	4.21	6.50	6.01	5.48
Density (mass per unit volume), kg/cm^3	0.49	0.58	0.57	0.57	0.63	0.60
Thermal conductivity at 25 ± 3°C, W/(m · K)	0.096	0.108	0.095	0.100	0.092	0.110
Structure factor	0.90	0.90	0.94	0.96	0.90	0.97

The samples were prepared using the following technology.

The diatomite was dried in a desiccator to moisture content 5 – 7%, after which it was ground in a ball mill. The ground diatomite was passed through a sieve with 1.0 mm openings. According to the data of [3], the initial activity of the diatomite varies with its dispersity. For grain size 0.3 – 1.0 mm, when the natural porosity is preserved, the activity of the diatomite is high. The sieved diatomite was mixed with diatomaceous dust and sawdust, and mixed with water to which liquid glass was added. The paste was carefully mixed and allowed to stand in a moist medium for 1 day. Next, samples were formed from this paste and, after being dried to moisture content 9 – 10%, calcined at temperature 1000°C. The density of the articles, the ultimate strength under compression, and the lineal shrinkage on drying and calcination were determined according to GOST 171773–81 and GOST 17177.15–81.

The compositions of the mixes are presented in Table 1.

The mix components were mixed with water to normal molding moisture content.

The physical-mechanical properties of the calcined samples are presented in Table 2.

As follows from the results of the tests, heat-insulating brick is grade 500 – 600 and its compression strength is 4.0 – 5.5 MPa, while according to TU 5764-002-25310144–99 the ultimate strength under compression of foam-diatomaceous heat-insulating brick of grade 500 is 1.0 MPa (according to TU 5764-002-25310144–99). In addition, it is much easier to manufacture heat-insulating brick by plastic molding and cheaper than by means of the slip method.

REFERENCES

1. V. N. Ivanenko and Ya. G. Belik, *Silica Rock and New Possibilities for Its Application* [in Russian], Izd. Kharkov. Univer., Kharkov (1971).
2. G. É, Goryainov, et al., Technology *of Mineral Heat-Insulating Materials and Light Concretes* [in Russian], Stroiizdat, Moscow (1976).
3. V. N. Solomatov, S. F. Koren'kova, and N. G. Chumachenko, "New approach to the problem of salvaging wastes in the construction industry," *Stroit. Mater.*, No. 1, 23 – 25 (2000).